BE IT KNOWN that We, ***Konrad DANKOWSKI and Uwe STEIMEL***, have invented certain new and useful improvements in

DEVICE FOR AND METHOD OF HEIGHT ADJUSTMENT OF SEAT WITH A DRIVE MOTOR

of which the following is a complete specification:

BACKGROUND OF THE INVENTION

The present invention relates to a device for and a method of height adjustment of a seat by means of a drive motor.

Seats of vehicles, such as for example seats for occupants of motor vehicles are often provided nowadays with electrical drive motors. Based on cost considerations and also in view of on-board current supply, per occupant seat one drive motor has been provided, which acts on two transmissions. In order to avoid tilting of the seat during its upward and downward movements, it is important to drive both transmissions synchronously, to produce an adjusting movement of the seat which is perceived by the seat occupant as uniform movement.

With synchronous electric motors which drive two seat adjusting transmissions, a play is positively produced by force transmitting elements such as couplings or transmission components, in a drive train from the corresponding driven shafts of the electric motor to the components which provide the vertical adjusting movement. The play is adjustable at the articulation points, or in other words in the connection points of the drive components. The changeable speed leads to different lifting paths in the

drives of the vertical movement of the seat. Furthermore, when different transmissions are used, which can be the case from the reasons of the structural space and costs, then the manufacturing tolerances of the used transmissions also can lead to different lifting paths at the transmissions, which involves a tilting of the seat surface during vertical adjustment of the seat.

During mounting of a vehicle seat, for example in a motor vehicle, the transmission which produces the vertical movement of the seat surface is incorporated in the extended condition. After this an adjustment of the vehicle seat downwardly is performed, until the transmission travels with a small lifting path to its abutment position. Subsequently, the adjusting transmission for the vertical movement of the vehicle seat is uncoupled at the opposite side manually from the drive motor and manually turned to its abutment position. These process steps are complicated, both with respect to the mounting cycle and the operational expenses. Furthermore, they represent an unavoidable error source during the adjustment of the vehicle seat drive. If to the contrary, the adjustment does not occur, the drive motor further rotates due to the available play and the elasticity in the drive current, and the transmission can be not further driven to its abutment position. This further drive movement can cause a lateral tilting of the seat which is not

acceptable. The further driving of the transmission which does not travel to its abutment position and moves “free” is the cause for an undesirable tilting of the seat surface.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a device for height adjustment of a seat with a drive motor, which avoids the disadvantages of the prior art.

In keeping with these objects and with others which will become apparent hereinafter, one feature of present invention resides, briefly stated, in a device for a height adjustment of a vehicle seat, comprising a drive motor; transmissions having different lifting strokes and operating synchronously, one of said transmissions reaching an abutment earlier than the other of said transmissions; housing provided for said transmissions and having abutment surfaces; and an abutment surface arranged so that at reaching a maximum position of a vehicle seat a transmission housing element abuts against said abutment surface so that a braking moment which exceeds a drive moment of said drive motor is produced.

When the device is designed in accordance with the present invention, the drive block of the drive motor upon reaching of the first

abutment position, prevents a further running of the drive motor for preventing the further process of the further transmission which does not travel to its abutment, by applying a braking moment exceeding the drive moment of the drive motor. Despite different lifting paths and different adjustable play or different manufacturing tolerances of the utilized transmissions, transmissions with different lifting paths are further adjusted. The proposed inventive solution of the drive block of the drive motor which drives the vertical drive can be realized in advantageous manner without an incorporation of additional parts. This leads as a whole to a lowering of the manufacturing and mounting costs, since the adjusting process, or in other words the manual uncoupling of the transmission with the long lifting path during the mounting of the seat, can be completely dispensed with.

With the elimination of the manually performed adjustment at the transmission with the longer lifting path on the vertical adjustment of the vehicle seat, the error source is excluded, which occurs during a manually performed adjustment. The mounting of the inventive seat height adjustment can be performed rationally and in short mounting time, so that an automation of the mounting is possible.

In an advantageous manner the braking moment is produced exactly when by the reaching of the maximum position of the transmission with the short lifting path, two surfaces abut against one another in a contact region. The contact region, at which the one end surface with a further end surface adjustable by deformation produces the braking moment, is located with respect to the threaded spindle producing the vertical adjusting moment in a radius to a symmetry line of each threaded spindle. If a distance between the contact surface at which the braking moment is produced and the symmetry line of the driving threaded spindle is selected sufficiently high, then the magnitude of the braking moment is influenced and adjusted so that the magnitude of the drive moment of the drive motor is exceeded, with which it adjusts the transmission with a longer lifting path traveling to its abutment position.

The braking moment can be, in addition to the suitable dimensioning of the radius with respect to the symmetry axis of the threaded spindle, also influenced by the surface property of the contacting abutment surfaces. This can be provided for increase of a higher friction value, with coatings which have a higher friction coefficient. In the manufacture, it can be achieved especially simple by providing the abutment surfaces with an increased roughness. For obtaining the roughness over the service life of

the automatic seat stroke adjustment, the abutment surfaces which have an increased roughness can be hardened, so that it is guaranteed that the braking moment is always produced during the contact of the abutment surface with the deformable abutment surface of a housing element. With the use of roughness surfaces which can be produced in an especially simple manner and lead to a reduction of manufacturing costs, the increase of the adjustment force of the fixed abutment surface and the deformed abutment surface can be advoided, so that the material loading is reduced.

In an especially advantageous manner, with the use of the inventive solution no additional components inside an adjusting drive of a vehicle seat are needed. By forming a housing element which is available in the transmission housing of the transmission with a short lifting path, such as for example the housing cover as a deformable component, a deformation which is sufficient for the contact with the fixed abutment surface is reached to provide a tensioning path s during reaching of the maximum position of a threaded spindle of the angular transmission with a short lifting path. Thereby no additional mounting works are needed, the mounting to the contrary is provided rationally, and an automation is possible.

The novel features which are considered as characteristic for the present invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a view showing one of two angular transmission with different lifting paths of a synchronously operating drive motor, which is arranged centrally between both transmissions;

Figure 2 is a cross-section through the transmission with a shorter lifting path together with a bearing with a bearing flange; and

Figure 3 is an enlarged view of the contact region at the angular transmission with the shorter lifting path, which produces a braking moment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 shows two angular transmissions with different lifting paths, which are driven by a synchronously driven drive motor.

The drive motor 1 which is formed as an electric motor as shown in Figure 1 is located between two transmissions 2 and 3 which produce the vertical movement of a vehicle seat. The angular transmission 2 which provides a vertical adjustment is a transmission with a short path of its threaded spindle 12. The angular transmission which is identified with reference numeral 3 has a lifting path which exceeds the lifting path of the above mentioned angular transmission 2. For synchronous driving of the both angular transmissions 2 and 3, the drive motor 1 is provided with two driven shafts 5 and 6. A coupling element 7 is connected to the driven shaft 5 by a driven element 8. The coupling element 7 drives with a multi-wedge profile 9 the angular transmission with the short lifting path. With this drive, a threaded spindle 12 which extends downwardly from a transmission housing 14 is driven in rotation. The threaded spindle 12, in turn, is mounted on a bearing flange 4, in which a perforated plate 13 is received, as can be seen from Figure 2.

The drive motor 1 which is formed as an electric motor includes on the other hand a long driven shaft 6 which acts through a driven element 11 with a longitudinal compensation, for example a multi-wedge profile or a similar element, on a coupling element 10. The coupling element 10 at the transmission side is connected through a multi-wedge profile 9 with the angular transmission 3 with a higher lifting path. The threaded spindle of the angular transmission 3 is driven in rotation through the coupling element 10 and the drive shaft 6, and through the force transmitting elements 11 or 9. The angular transmission, analogously to the view at the opposite angular transmission 2, is articulated to a bearing flange. Instead of the above mentioned multi-wedge profiles 9, 8, 11, it is possible to use other coupling elements which provide a longitudinal compensation or a longitudinal expansion, such as for example a number of keys at the force transmitting locations.

A sectional view through the angular transmission with a shorter lifting path with a total support in bearing flange is shown in Figure 2. The angular transmission 2 shown in Figure 2 is illustrated in a longitudinal section. The spindle 12 mentioned in connection with Figure 1 is received in the transmission housing 14 of the angular transmission 2 with a short lifting path. The threaded spindle 12 is formed rotation-symmetrically to its

axis of symmetry 22 and embraces an expanded threaded head region which carries an outer transmission, cooperating with an inner transmission 17 of a threaded sleeve 15. The threaded sleeve 15 which has a throughgoing opening with the inner thread 17, is driven in its base region 18. For this purpose in the base region 18 of the threaded sleeve 14, an outer tooth set 20 is provided. The outer set 20 of the threaded sleeve 14 engages in the base region 18 with a worm drive 19. The latter, on the one hand, is driven by the driven moment of the drive motor 11 and through the coupling 7 or the multi-wedge profile connection 9.

With the self-engaging worm transmission 19 and the outer tooth set 20 it is guaranteed that at reaching a vertical adjusting position of the seat surface, or in other words a predetermined adjusting position of the bearing flange 4, the seat remains in the adjusted position and can not move from it unintentionally.

A transmission cover 21 is located in the lower region of the transmission housing 14. It is deformable by a tensioning path s shown in Figure 3 in a limited range. For this purpose, on the transmission cover 21 at the lower side, abutments 24 are formed symmetrically to the threaded spindle 12. When the threaded spindle 12 travels to its maximum position,

the bearing flange 14 abuts with its abutment surface 23 against the lower side of the abutment 24 formed on the transmission housing cover 21.

A ball body 25 is received in the lower region of the transmission spindle 12. With tensioning element 26, for example a screw or the like, the ball body 25 supported on the lower side of the transmission spindle 12 is fixed in a longitudinal groove 27 of the transmission spindle. Thereby the bearing flange 4 is fixedly connected with the transmission spindle which in turn is non rotatable, since the threaded sleeve 14 is driven via the worm drive and is rotatably moved in turn in the transmission housing 12 of the angular transmission 2.

Figure 3 shows an enlarged illustration of the abutment or contact region on the transmission with a short lifting path which produces the braking moment, on a significantly enlarged scale. As can be seen from Figure 3, abutments 24 are formed at the lower side of the transmission housing element 21, or in other words the transmission housing cover. The abutment 24 which is located at the opposite side of the line of symmetry 22 of the threaded spindle 12 is not shown for the reasons of visibility. When the abutment surface 23 of the bearing flange 24 is moved upwardly so that the surface 23 contacts the abutment 24 on the transmission housing cover

21, the transmission housing cover 21 is deformed by a tensioning angle s identified with reference numeral 30. Thereby the contact surface 32 formed on the transmission housing cover abuts against the opposite end side of the threaded sleeve 15. This contact location is located preferably at a radius 28 with respect to the axis of symmetry 22 of the threaded spindle 12. Thereby a drive block is produced, so that the braking moment 31 which acts on the threaded spindle 12 is greater than the drive moment of the drive motor 1, which drives the oppositely located, freely traveling angular transmission 3 with a longer lifting path. The braking moment 31 is formed by the radius 21 between the line of symmetry 22 and the contact region of the surface 32 at the transmission housing cover 21 and the opposite end surface of the threaded sleeve 15.

A reduction of the mechanical loading of the components 15 and 21 during their tensioning over the tensioning path 30 can be obtained in that, the pre-tensioning force can be reduced by forming the threaded sleeve 15 in the region of its abutment surface as well as the valve cover 21 on its abutment surface 32 with a surface having higher friction coefficient μ. Thereby with a lower pre-tensioning force, a sufficiently high friction force is produced, so that the generation of the braking moment 31 is guaranteed and simultaneously the long-term loading during the tensioning of the valve

cover 21 against the end surface at the threaded sleeve 15 is considerably lowered.

Figure 3 shows the position of the outer tooth set 20 on the threaded sleeve 15, which in turn contains the inner thread 17, cooperating with the outer thread on the threaded head 16 of the threaded spindle 12. The drive moment of the drive worm 19 is introduced in the region of the outer tooth set, so that by selection of a smaller radius 28, which is smaller than the radius 28 shown in Figure 3, a braking moment 31 which exceeds the driven moment of the drive motor 1 can be produced.

From the manufacturing point of view it is especially simple when the surfaces 32 of the housing cover 21 and the end surface 15 of the threaded sleeve 15, in addition to a treatment with a high roughness, can be provided with friction increasing coatings. Therefore, a sufficiently high friction force can be produced.

The braking moment 31 which is produced by the contact of the end surface of the threaded sleeve 15 with the transmission housing cover 21 deformed by the tensioning angle s identified with reference numeral 30, operates as a drive block of the drive motor 1, which when not blocked by

the braking moment 31 can drive the opposite angular transmission 3 with a higher lifting stroke further, so that it can lead to a tilting of the vehicle seat. With the braking moment produced at reaching of the maximum position of the transmission with the shorter lifting path 2, the drive moment 1 is stopped in accordance with the proposed solution, without the use of further components and parts in an automatic seat height adjustment of a vehicle seat. Thereby it is possible to utilize the angular transmissions 2 and 3 which are produced in a mass production and have different manufacturing tolerances and lifting strokes. The location of the maximum position of the transmission 2 with a shorter lifting path determines the end of the drive movement of the angular transmission 3 which is "free" and not in its abutment position, during the height adjustment of the vehicle seat.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in device for and method of a height adjustment of seat with a drive motor, it is not intended to be limited to the details shown, since various

modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.